



A Holistic Approach to Blood Glucose Management: Foot Exercise and Laughter Therapy in Older Adults with Type II Diabetes Mellitus

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ABSTRACT

This study compares the effectiveness of foot exercise and laughter therapy in reducing blood glucose levels in older adults with Type II Diabetes Mellitus. The objective is to determine which intervention has a greater impact on lowering blood glucose and promoting overall well-being. An independent samples t-test was conducted to compare the reduction in mean blood glucose levels between two intervention groups: foot exercise and laughter therapy. The assumption of equal variances was met based on the results of Levene's test ($p > 0.05$). Both interventions resulted in significant reductions in blood glucose levels, but laughter therapy showed a slightly greater reduction. Foot exercise improved insulin sensitivity and glucose uptake, but may not be suitable for individuals with mobility issues. In contrast, laughter therapy not only reduced blood glucose levels but also promoted psychological benefits such as improved mood and reduced anxiety, which are crucial for diabetes management. The accessibility and lower physical demands of laughter therapy make it an attractive option for older adults, especially those with physical limitations. The findings suggest that laughter therapy offers a more holistic approach to diabetes management by addressing both physical and emotional well-being. This study highlights the potential of laughter therapy as a sustainable, low-impact intervention for improving health outcomes in older adults with Type II Diabetes Mellitus.

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1. INTRODUCTION

Diabetes mellitus (DM) is a chronic metabolic disease characterized by increased blood glucose levels, which poses a risk of causing serious damage to other organs [1]. Type II DM typically occurs in adults and happens when the body becomes resistant to insulin due to inadequate insulin production [2]. Diabetes mellitus is one of the leading causes of death worldwide, accounting for 1.5 million deaths in 2019 due to DM [3]. The number of DM patients worldwide in 2021 was 537 million adults (aged 20-79 years), with a higher risk in low- and middle-income countries [4]. According to the Indonesian Health Survey 2023, the prevalence of DM in Indonesia was 638.178 people, South Sumatra Province ranks 6th in the number of DM patients in Indonesia, with 19,474 cases [5].

The management of hyperglycemia through hyperglycemia management, medication education programs, and drug administration (Tim Pokja SIKI DPP PPNI, 2018) is essential. Hyperglycemia management must be carried out alongside pharmacological and non-pharmacological therapies. Pharmacological therapy includes insulin administration, while non-pharmacological therapies include weight control, exercise, complementary medicine, alternatives, and diet [6]. Several studies have shown that DM patients often neglect their condition because they feel asymptomatic, or due to time constraints. Therefore, the Directorate of P2PTM KEMENKES RI recommends non-pharmacological therapy assistance that can be done while relaxing with family, anytime and anywhere, and can be performed individually or in groups later [7].

Complementary therapies that are low-cost and have been proven to reduce blood glucose levels in older adults people with DM, and can be performed independently, include laughter therapy [8]. Laughter therapy inhibits the hypothalamus from secreting CRH, ACTH, and cortisol, allowing the body to produce endorphins and inhibit the release of glucocorticoid hormones. This effect can improve sleep quality and blood glucose levels, thus making it a recommended non-pharmacological treatment for older adults people with type 2 DM [9].

Laughter therapy, known as therapeutic humor, combines mind and body techniques to reduce stress hormone levels, such as epinephrine and cortisol, while stimulating the mesolimbic dopaminergic system, which mediates pleasure and induces a relaxed and calm state, thus influencing both physical and psychological health in the older adults [10]. Laughter therapy can be done spontaneously through media like videos, stories, or humorous images, or it can also be done with stimulation. According to [11], laughter therapy with stimulation is more effective than spontaneous laughter therapy. Research by Candra et al. (2014) indicated that non-pharmacological therapies like laughter therapy, conducted for 12 weeks with sessions lasting 20-30 minutes (20-40 seconds per session), at Puskesmas IV Denpasar, led to reduced blood glucose levels in type II DM patients (Candra, 2014). Laughter therapy engages facial muscles and internal organs such as the heart, lungs, chest, diaphragm, and abdomen. These movements stimulate the brain to suppress epinephrine and cortisol secretion and promote the release of endorphins, inducing feelings of calm and comfort [13].

According to Ahmadi et al (2020) “laughter therapy is more effective in enhancing hope, compassion, and reducing hyperglycemia in older adults patients with type II diabetes compared to solution-based therapy” [8]. Candra & Sumirta's 2014 research found that laughter therapy over 8-12 weeks reduced blood glucose levels in diabetes mellitus patients [12]. Additionally, Hirosaki et al (2023) found through randomized controlled trials that laughter yoga programs over 12 weeks could improve blood glucose control and be a pleasant self-care intervention for individuals with type II diabetes [14]. The mechanism of laughter therapy on blood glucose involves inhibition of the hypothalamus in secreting CRH, ACTH, and cortisol, thereby enabling the body to produce endorphins and inhibit glucocorticoid hormone release [14]. The effects of laughter therapy include improved sleep quality and blood glucose levels, recommending it as a non-pharmacological treatment for older adults individuals with type II DM [9].

The purpose of this study is to explore the effectiveness of laughter therapy in helping manage blood glucose instability in patients with type II diabetes mellitus. Based on the mechanisms outlined by Wibowo et al., (2024), this research with case study method to aims to assess the impact of laughter therapy on older adults health, particularly in terms of stress reduction, improved blood circulation, oxygen distribution, insulin sensitivity, and sleep quality. Additionally, the study seeks to understand how laughter therapy may serve as a form of light physical exercise that could increase insulin sensitivity and assist the body in utilizing glucose more efficiently (Wibowo et al., 2024).

The aim of this research is to assess the effectiveness of laughter therapy in managing blood glucose levels in individuals with type II diabetes mellitus. By using laughter therapy, specifically through laughter therapy cards designed by the researcher, the study seeks to explore its potential as an alternative non-pharmacological intervention for older adult patients with DM. The effectiveness will be evaluated by monitoring changes in blood glucose levels before and after the implementation of the therapy, considering factors such as the overall impact on emotional well-being and physiological health. This research intends to provide evidence on the role of laughter therapy in improving glycemic control and enhancing the quality of life for DM patients, offering valuable insights for integrating such complementary therapies into diabetes management programs.

2. RESEARCH METHOD

This study will use a quasi-experimental design to assess the effectiveness of using a laughter therapy card on blood glucose levels in older adults with Type II Diabetes Mellitus (DM) in the city of Lubuklinggau. The study will involve 40 older adult participants, divided into two groups, each comprising 20 individuals.

2.1. Sample Selection

The study will involve older adult individuals diagnosed with Type II Diabetes Mellitus in Lubuklinggau, who meet the inclusion and exclusion criteria.

Inclusion Criteria:

- Participants aged 55 years or older.
- Diagnosed with Type II Diabetes Mellitus.
- Willingness to participate in all study activities until completion.

Exclusion Criteria:

- Individuals with neurological disorders.
- Individuals with hemorrhoids.
- Individuals with hernia.
- Individuals with cardiovascular disease.
- Individuals experiencing respiratory issues (e.g., shortness of breath).



- f. Individuals who have recently undergone surgery.
- g. Individuals with eye complications, such as glaucoma.

2.2. Study Groups

The participants will be divided into two groups:

Group 1: Laughter Therapy Card group, which will receive the laughter therapy card intervention.

Group 2: Control group, which will receive regular care but no laughter therapy card intervention.

2.3. Intervention

Group 1: The laughter therapy card, a tool designed to promote laughter and improve emotional well-being, will contain various exercises such as humorous prompts, visual aids, and instructions to help stimulate laughter. Participants will be instructed to use the card daily for 4 weeks, with 8 sessions in total. Each session will last between 30 to 60 minutes.

Group 2: The control group will perform foot exercises for the same duration and frequency as the laughter therapy card group.

2.4. Statistical Analysis

The data will be analyzed using descriptive statistics to summarize the characteristics of the participants. To assess the effectiveness of the laughter therapy card, paired t-tests will be conducted within each group (Laughter Therapy Card and Control Group) to compare pre- and post-intervention blood glucose levels. Additionally, an independent t-test will be used to compare the changes in blood glucose levels between the two groups. A significance level of $p < 0.05$ will be set for all tests to determine whether the intervention significantly affected blood glucose control.

2.5. Ethical Considerations

This study has received ethical clearance from the Ethical Committee of Poltekkes Kemenkes Palembang, with clearance number 0756/KEPK/Adm2/V/2024. All participants will provide informed consent, and their confidentiality will be maintained throughout the study.

3. RESULTS AND ANALYSIS

Based on Table 1 below this line, the majority of participants were female (60%), with 16 males (40%). The age group with the highest frequency was 60-64 years, accounting for 30% of the participants, followed by 25% in the 65-69 years group, and 25% who were 75 years and above. The least represented age group was 70-74 years, comprising 20% of the respondents.

Regarding educational level, the majority of participants had completed elementary school (30%) or high school (35%). Only 10% had no formal education, while 25% had attended college or higher education. In terms of occupation before retirement, housewives represented the largest group (30%), followed by farmers (25%), teachers (20%), and office workers (15%). The least represented occupation was self-employed individuals, making up 10% of the respondents.

When it comes to comorbidities, half of the participants had hypertension (50%), followed by those with heart disease (12.5%) and stroke (7.5%). However, 30% of respondents reported having no comorbidities. As for the duration of diabetes, 37.5% of respondents had been living with diabetes for 5-10 years, while 32.5% had it for more than 10 years. The least common duration was less than 5 years, comprising 30% of the sample.

In terms of exercise frequency, 45% of participants exercised occasionally (1-2 times per week), while 30% led a sedentary lifestyle, and 25% exercised regularly (3+ times per week). Regarding dietary habits, 45% of respondents had a high-sugar and low-fiber diet, followed by 30% who followed a strict low-carb or diabetic-friendly diet. The least common dietary habit was a balanced diet, accounting for 25% of the respondents.

Table 1. Distribution of Respondents

Characteristic	Category	Frequency (n)	Percentage (%)
Age	60-64 years	12	30%
	65-69 years	10	25%
	70-74 years	8	20%
	75 years and above	10	25%

Gender	Male	16	40%
	Female	24	60%
Educational Level	No formal education	4	10%
	Elementary school	12	30%
	High school	14	35%
	College or higher	10	25%
Occupation Before Retirement	Farmer	10	25%
	Teacher	8	20%
	Office worker	6	15%
	Self-employed (business owner)	4	10%
Comorbidity	Housewife	12	30%
	Hypertension	20	50%
	Heart disease	5	12.5%
	Stroke	3	7.5%
Duration of Diabetes	Nothing	12	30%
	< 5 years	12	30%
	5-10 years	15	37.5%
	> 10 years	13	32.5%
Exercise Frequency	Regular exercise (3+ times/week)	10	25%
	Occasional exercise (1-2 times/week)	18	45%
	Sedentary lifestyle	12	30%
Dietary Habits	Balanced diet	10	25%
	High-sugar and low-fiber diet	18	45%
	Strict low-carb or diabetic-friendly diet	12	30%

Table 2. Analysis of The Effect of Foot Exercise in Older Adults with Type II Diabetes Mellitus

Group	Mean (Before) ±SD	Mean (After) ±SD	Mean Difference	p-Value*
Foot Exercise	290.90 ± 26.20	206.80 ± 14.01	84.10	0.001

***Paired t-Test**

Based on table 2. Analysis of The Effect of Foot Exercise in Older Adults with Type II Diabetes Mellitus, the results indicate that Foot Exercise significantly reduced blood glucose levels in older adults with Type II Diabetes Mellitus. Before the intervention, the mean blood glucose level was 290.90 ± 26.20 mg/dL, which decreased to 206.80 ± 14.01 mg/dL after the intervention. The mean difference of 84.10 mg/dL demonstrates a notable reduction in blood glucose levels. The p-value of 0.001 confirms that this reduction is statistically significant, suggesting that Foot Exercise is effective in improving blood glucose control in this population.

According to Table 2, the analysis of the impact of Foot Exercise on older adults with Type II Diabetes Mellitus revealed a significant decrease in blood glucose levels. The average blood glucose level prior to the intervention was 290.90 ± 26.20 mg/dL, which dropped to 206.80 ± 14.01 mg/dL after the intervention. This represents a mean reduction of 84.10 mg/dL. With a p-value of 0.001, the findings confirm that this decrease is statistically significant, highlighting the effectiveness of Foot Exercise in improving blood glucose regulation in older adults with Type II Diabetes Mellitus.

a study conducted in the Baraka Community Health Center reported a significant decrease in blood glucose levels with a p-value of 0.000, indicating the effectiveness of foot exercises when performed three times a week for 30 minutes [17]. Similarly, another study found that diabetic foot exercises led to a decrease in postprandial blood glucose levels, with a p-value of 0.001, further supporting the intervention's efficacy [18]. The literature review by Wibowo and Dwiastuti corroborates these findings, highlighting that all ten reviewed studies reported a reduction in blood sugar levels following foot exercise therapy [19]



Additionally, research conducted at the Tanjunganom Public Health Center demonstrated that foot exercises not only reduced blood glucose levels but also improved sensory neuropathy status in the lower extremities [20]. These exercises are particularly beneficial for older adults who may face physical and time constraints, as they can be performed easily and without the need for specialized equipment [21]. The consistent findings across various studies underscore the potential of foot exercises as a non-pharmacological intervention to manage blood glucose levels in older adults with Type II Diabetes Mellitus, offering a practical and accessible means to improve their quality of life [22].

Physical exercise involving physical activity and muscle contractions can enhance insulin sensitivity, allowing the body to utilize available insulin more effectively to absorb glucose and convert it into energy [23]. Several studies indicate that individuals with diabetes often struggle to engage in physical activity due to time constraints. To address this, the Directorate of Non-Communicable Disease Prevention and Control (P2PTM) recommends physical activities that can be performed anywhere, even while relaxing with family, such as diabetes foot exercises [7].

According to [24], foot exercises have been shown to lower blood glucose levels and improve the ankle-brachial index (ABI) in individuals with diabetes. Diabetes foot exercises can aid blood circulation, strengthen small foot muscles, prevent foot deformities, and address insulin deficiencies in people with diabetes [25]. Research by Arif, (2020) further indicates that foot exercises are not only effective in reducing blood glucose levels but also in increasing nitric oxide synthesis, arterial vasodilation, hemoglobin oxygen affinity, and blood viscosity, while enhancing blood circulation, oxygen saturation, and tissue perfusion.

Table 3. Analysis of The Effect of Laughter Therapy in Older Adults with Type II Diabetes Mellitus

Group	Mean (Before) ±SD	Mean (After) ±SD	Mean Difference	p-Value*
Foot Exercise	303.35 ± 30.78	107.55 ± 13.09	107.55	0.001

**Paired t-Test*

Laughter Therapy also demonstrated a significant effect on reducing blood glucose levels in older adults with Type II Diabetes Mellitus. The mean blood glucose level before the intervention was 303.35 ± 30.78 mg/dL, which decreased to 195.80 ± 13.09 mg/dL after the intervention. The mean difference of 107.55 mg/dL highlights a substantial reduction in blood glucose levels. With a p-value of 0.001, this result is statistically significant, indicating that Laughter Therapy is an effective non-pharmacological intervention for blood glucose management in older adults with Type II Diabetes Mellitus.

Laughter Therapy revealed a significant reduction in blood glucose levels. Prior to the intervention, the average blood glucose level was 303.35 ± 30.78 mg/dL, which decreased to 195.80 ± 13.09 mg/dL following the therapy. This represents a substantial mean reduction of 107.55 mg/dL. With a statistically significant p-value of 0.001, these findings underscore the effectiveness of Laughter Therapy as a non-pharmacological approach for managing blood glucose levels in older adults with Type II Diabetes Mellitus.

Several studies have demonstrated that laughter therapy is an effective non-pharmacological intervention for managing blood glucose levels in individuals with Diabetes Mellitus (DM) [27]. Research by Ahmadi et al (2021) revealed that laughter therapy significantly reduced hyperglycemia in older adults with type 2 diabetes compared to solution-based therapy and control groups after a two-month intervention. Similarly [28], Candra & Sumirta (2014) found that laughter therapy conducted over 12 weeks, with sessions lasting 20-30 minutes, effectively lowered blood glucose levels in DM patients in South Denpasar [12].

Wirawan et al. (2020) highlighted the benefits of laughter yoga therapy in reducing health problems among older adults during a nine-month intervention with two-hour sessions [29]. [30] reported that laughter yoga improved sleep quality and emotional well-being in female teachers with diabetes following eight therapy sessions, laughter yoga program not only improved glycemic control, as measured by hemoglobin A1c (HbA1c), but also enhanced psychological factors, sleep quality, and reduced waist circumference. These findings underscore the potential of laughter therapy as an enjoyable and beneficial alternative for managing blood glucose levels and improving the overall well-being of individuals with DM.

Laughter same as a yoga, has shown promising results in managing diabetes and improving blood glucose levels. A randomized controlled trial demonstrated that a 12-week laughter yoga program significantly improved glycemic control in individuals with type 2 diabetes, as evidenced by a reduction in HbA1c levels by 0.31% compared to the control group [14]. This aligns with findings from another study that highlighted the inhibitory effect of laughter yoga on postprandial blood glucose levels, suggesting that laughter can serve as a beneficial adjunct in diabetes management

[31]. Furthermore, laughter yoga not only aids in glycemic control but also enhances psychological well-being, which is crucial for managing chronic conditions like diabetes [14].

Complementary to laughter yoga, traditional yoga practices have also been extensively studied for their efficacy in diabetes management. Integrated yoga therapy has been shown to significantly improve fasting blood glucose, postprandial blood glucose, and HbA1c levels, along with reducing insulin resistance and improving lipid [32]. Additionally, long-term yoga practice has been associated with a decrease in fasting blood glucose and glycated hemoglobin levels, further supporting its role as an effective complementary therapy for diabetes [33]. While both laughter yoga and traditional yoga have demonstrated benefits in managing diabetes, laughter yoga offers a unique, enjoyable approach that can be easily integrated into daily routines, potentially increasing adherence and enhancing overall quality of life for individuals with diabetes [31].

Table 4. Comparison of The Effectiveness of Foot Exercise and Laughter Therapy on Blood Glucose Levels

Group	Mean (Before) \pm SD	Mean (After) \pm SD	t	Levene's Test (F)	p-Value*
Foot Exercise	290.90 \pm 26.20	206.80 \pm 14.01	25.967	3.738	0.061
Laughter Therapy	303.35 \pm 30.78	195.80 \pm 13.09	25.437		

***Independent t-Test**

Based on table 4, an independent samples t-test was conducted to compare the reductions in mean blood glucose levels between the two intervention groups: foot exercise and laughter therapy. Both the assumption of equal variances and the alternative scenario were considered in the analysis. Levene's Test for Equality of Variances indicated an F-value of 3.738 with a p-value of 0.061. Since the p-value exceeds 0.05, the assumption of equal variances holds, and the "equal variances assumed".

Both interventions, foot exercise and laughter therapy, show significant differences in pre- and post-intervention mean blood glucose levels. Laughter therapy demonstrating a slightly higher difference in blood glucose reduction compared to foot exercise. The majority of participants were female (60%) and aged 60-64 years (30%). Most had completed elementary school (30%) or high school (35%). Housewives were the largest group (30%), followed by farmers (25%). Half of the participants had hypertension (50%), and 37.5% had lived with diabetes for 5-10 years. Exercise frequency was highest among those who exercised occasionally (45%), and 45% followed a high-sugar, low-fiber diet. The demographic and health characteristics of the study participants reflect a significant prevalence of chronic conditions such as hypertension and diabetes, particularly among older adult women. The majority of participants were female, with a notable proportion aged between 60-64 years, aligning with findings that highlight the vulnerability of older adults women to non-communicable diseases (NCDs) like hypertension and diabetes [34].

Educational attainment varied, with most participants having completed elementary or high school, which is consistent with studies indicating lower educational levels among older adults populations with chronic diseases [35]. The occupational distribution showed a predominance of housewives and farmers, occupations that have been associated with higher incidences of diabetes and hypertension due to lifestyle factors [36]. Hypertension was prevalent in half of the participants, a common trend observed in older adults populations across various studies [36]. Additionally, a significant portion of participants had lived with diabetes for 5-10 years, underscoring the chronic nature of these conditions [35].

Exercise habits were suboptimal, with the highest frequency among those who exercised occasionally, reflecting a broader trend of insufficient physical activity among older adults populations, which is a known risk factor for both diabetes and hypertension [34]. Dietary patterns were concerning, with 45% following a high-sugar, low-fiber diet, a dietary habit linked to increased risk of chronic diseases [35]. These findings highlight the need for targeted public health interventions focusing on improving lifestyle factors such as diet and physical activity to manage and prevent the progression of chronic diseases in older adults populations [37].

Based on Table 4, an independent samples t-test was performed to compare the reductions in mean blood glucose levels between the two intervention groups: foot exercise and laughter therapy. The analysis considered both the assumption of equal variances and the alternative scenario. Levene's Test for Equality of Variances yielded an F-value of 3.738 with a p-value of 0.061. Since the p-value is greater than 0.05, the assumption of equal variances was met, allowing the analysis to proceed under the "equal variances assumed" condition. Both interventions, foot exercise and laughter therapy, demonstrated significant reductions in mean blood glucose levels from pre- to post-intervention. However, laughter therapy resulted in a slightly greater reduction in blood glucose levels compared to foot exercise.



Both foot exercise and laughter therapy have shown significant effectiveness in reducing blood glucose levels in older adults with Type II Diabetes Mellitus, but each intervention has distinct strengths and limitations. Foot exercise, as demonstrated in multiple studies, has consistently led to notable reductions in blood glucose. For example, studies at Baraka Community Health Center and Tanjunganom Public Health Center report that regular foot exercises, performed three times a week, effectively decrease blood glucose levels and improve sensory neuropathy in the lower extremities [17], [20]. This form of physical activity works by enhancing insulin sensitivity and promoting better glucose uptake by cells, making it an essential intervention for diabetes management [23]. However, foot exercise may be challenging for individuals with physical limitations or mobility issues, potentially reducing its accessibility and long-term adherence.

On the other hand, laughter therapy has demonstrated a greater reduction in blood glucose levels, with some studies reporting a reduction of up to 116 mg/dL (Wibowo et al., 2024). Laughter therapy is not only effective in reducing hyperglycemia but also promotes psychological well-being, which is crucial for diabetes management (Wibowo, et al., 2024). Research has shown that laughter therapy can enhance mood, reduce anxiety, and improve overall emotional health, factors that indirectly contribute to better glycemic control [38]. Additionally, laughter therapy is less physically demanding, making it more accessible for individuals with mobility issues or those who struggle with other forms of physical activity. Studies have also highlighted its positive impact on other health aspects, such as improved sleep quality and reduced waist circumference [30].

Laughter therapy stands out as a more holistic intervention because it simultaneously addresses physical, emotional, and social well-being, which is critical in managing chronic conditions like diabetes. Unlike foot exercise, which primarily targets physical health, laughter therapy's ability to enhance psychological factors such as mood and stress levels makes it a compelling option. Furthermore, laughter therapy can be practiced easily at home, often in a group setting, which fosters social interaction and adherence [14]. While foot exercise is an effective and practical intervention for managing blood glucose levels, laughter therapy offers additional psychological and emotional benefits that enhance overall well-being. Its lower physical demands and holistic approach make it a more accessible and sustainable option for older adults with Type II Diabetes Mellitus, potentially leading to higher long-term adherence and a better quality of life.

4. CONCLUSION

Both foot exercise and laughter therapy are effective interventions for reducing blood glucose levels in older adults with Type II Diabetes Mellitus. While foot exercise has been proven to reduce blood glucose levels by enhancing insulin sensitivity and improving glucose uptake, laughter therapy demonstrated a slightly greater reduction in blood glucose levels and offers additional psychological benefits. Laughter therapy is particularly beneficial due to its ability to improve mood, reduce anxiety, and enhance emotional well-being, which are important factors for diabetes management. Furthermore, laughter therapy is less physically demanding, making it more accessible for individuals with mobility limitations, thus promoting long-term adherence.

In conclusion, laughter therapy presents a more holistic approach by addressing not only physical but also emotional and social well-being, which may contribute to better overall quality of life and more sustainable diabetes management for older adults.

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